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A Comparative Study of Interior Designing Using Markerless Augmented Reality

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***Abstract*—Due to extensive advancements in technology of Augmented Reality and Virtual Reality, the hardware needed to support such technology is becoming obsolete. Spending time in physical stores becomes a tedious task for most people. They get confused which furniture to be purchased that will be best suited for their space. In an AR environment, the virtual 3D Model of a piece of furniture can be shown and adjusted in real-time on the screen, permitting the user to have an interactive involvement of the virtual furniture in a real-world environment, making it a more immersive experience.**
Augmented reality (AR) is the real-time use of information in the form of text, graphics, audio and other virtual enhancements integrated with real-world objects. It is this "real world" element that differentiates AR from virtual reality.
This paper introduces the concept of AR in the world of interior home design and will ease the process of selecting perfect furniture whilst saving the user's time.

***Index Terms*— Augmented Reality, Augmented Reality, 3D Model, AR.**

I. INTRODUCTION

It seems that every few years, people all over the world are increasingly using Augmented Reality [1] and 3D technology in their daily life. As computer technology gets better, augmented reality and 3D technology developed more rapidly. Augmented Reality (AR) employs computer vision, image processing and computer graphics techniques to merge digital content into the real world. It enables real-time interaction between the user, real objects and virtual objects. Augmented reality technology allows the user to have an interactive experience with the real world. Recently augmented reality (AR) furniture arrangement systems help users overlay virtual furniture onto the real world [2].

A. Types of Augmented Reality Techniques

Marker based AR

Marker-based AR application usually involves image recognition, the images that are to be recognized are predefined in the application. During runtime the app analyses the camera stream and tries to find a marker (target). Once it detects the marker, the AR markers are used as the location for rendering virtual objects. AR markers can include a wide range of images but usually these are small, two-dimensional barcodes known as data-matrix codes or it's a 2D image printed on something like a poster. The target is recognized via the camera by the augmented reality application device, the image is processed, the barcode is turned into a web address, and an appropriate web page is called up by the browser with further information. The benefit of using this tracking method is that it's more convenient to use as the markers or targets can be recognized easily by the camera. Also, a more stable, accurate, tied to a particular point image is obtained using the markers. Due to its simplicity of implementation, it is the more popular option currently[3]

Marker-less AR applications recognize objects that were not predefined. Application recognizes different features, patterns, colors etc., as there are no predefined image targets on the app. During runtime the app has to analyze the different variables in the camera frame to trigger AR actions. This tracking method works by using scanning algorithms and feature detection systems. Say, we want to find the information about some object, we can simply point our phone at it and have some kind of feature-detection or pattern identification systems try to recognize it. Specific scanning algorithms are used to identify it. It creates or projects a virtual grid on the image caught by our camera and to pinpoint the exact location, the automatic scan finds several anchor points and binds a virtual model to it. The marker less technology has many advantages including that the real-life object can serve as

a marker by itself and there is no overhead of making or creating markers on the objects. We don't have to make distinctive optical identifiers. The physical objects have the digital images and textures projected directly upon them. This is known as projection mapping and can be used to quite remarkable effects [3].

Based on our recent study, we discovered a research paper, based on an app that used marker less AR technology to demonstrate the rendering of 3D Models. The app mentioned in the research paper followed the following procedure:

1. Select furniture from a menu.
2. Place furniture by tapping on the screen.
3. Remove rendered furniture.
4. Change material of rendered furniture.
5. Move the location of furniture.
6. Take a picture of the current environment and store in the local storage.
7. Load 3d models from local storage [3].

We are trying to build a mobile app that allows the user to visualize and interact with the furniture using their smartphones, in an Augmented Reality environment. The app will use different sensors such as depth sensor and gyroscope to detect a planar surface. Upon the detection of the planar surface, a tap on the planar surface will place the 3D Model in the desired position. The app will use Markerless AR technology to place the 3D Model on the planar surface.

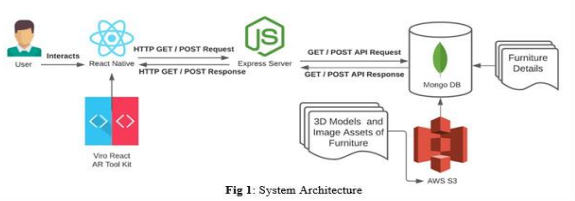

Fig 1: System Architecture

The system architecture that we propose is shown in fig1

a. React Native Application: Users can interact with the app such as sign in, sign up, view different products, view different products in a real-life environment using AR technology and order furniture. The App can work on both iOS and Android Smartphones. The app uses Viro React AR Tool Kit Library to utilize its APIs in order to render objects in a 3D environment.

b. Viro React AR Tool Kit: This open-source library provides APIs to achieve various AR/VR functionalities such as plane detection, 3D models rendering and object detection. Developers write in React Native, and Viro runs their code natively across all mobile VR (including Google Daydream, Samsung Gear VR, and Google Cardboard for iOS and Android) and AR (iOS ARKit and Android ARCore) platforms [4].

c. Express Server: Server built on Express framework, linking the frontend React Native Application and the MongoDB Database Server. d. MongoDB Database Server: It is a NoSQL database storing all the data including the application users and furniture in the form of documents.

e. AWS S3: Amazon S3 or Amazon Simple Storage Service is a service offered by Amazon Web Services (AWS) that provides object storage through a web service interface [5] [6]It stores furniture assets like 3D models, textures and their high-resolution images from all the sides (front, back, right, left, top, bottom).

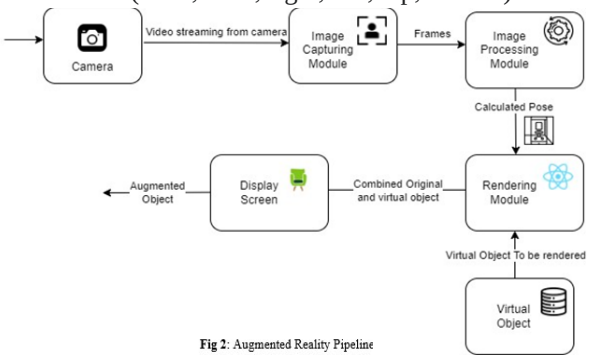

Fig 2: Augmented Reality Pipeline

Augmented Reality Pipeline is shown in Fig 2.

a) Camera: A continuous video frame is given as input to the camera of an android handset.

b) Image Capturing Module: The input to Image Capturing Module is given via camera i.e., live video frame. The module generates binary images This module analyses each frame in the video and generates the binary image consisting of only two values for each pixel i.e., 0 for black and 1 for white. This module also analyses the different variables in the camera frame to trigger AR actions.

c) Image Processing Module: The binary images generated by the Image Capturing Module are input to the Image Processing Module. This module firstly detects a planar surface and then calculates the position of it. Secondly, it calculates the relative position of the 3D object to be placed on the planar surface.

d) Rendering Module: The Rendering Module has 2 inputs. First is the calculated pose from the Image Processing Module and other is the 3D object to be augmented. It displays the augmented view on the screen of the android handset.

This framework utilizes React Native Framework for cross-platform application development, an Express Server as a backend server to enable resource sharing between frontend and a MongoDB NoSQL Database.

The framework also includes Amazon S3 which offers object storage for the 3D models, texture and their high-resolution images from all sides. The technology that will help us achieve AR functionality is Viro React. Viro React provides a great performance efficiency on iOS and Android platforms.

II. LITERATURE REVIEW

1.Markerless Augmented Reality Android App for Interior Decoration [7], published by Prasad Renukdas, Rohit Ghundiyal, Harshavardhan Gadgil and Vishal Pathare in April 2016. They proposed a method of Markerless Augmented Reality Android App.

A markerless application for interior decoration purposes, in which any novice user can easily decorate his/her home. They included their observations and reminisce on potential future improvements. This paper also discusses mobile applications of Augmented Reality (AR) on the Android platform. It discusses existing SDKs for developing AR applications on mobile platforms and elaborates their functionalities and limitations. The limitations in their technology were:

- Models are right now locally stored, resulting in high size of application and initial loading times.
- Models possess low shadow and reflection effects, resulting in a not-so-realistic feel.

Future scope stated by them was:

- The models can be stored on file hosting sites and loaded on demand.
- This will result in increased performance and low memory consumption and increased reliability; it will require the user to have a high-speed internet connection

2. Augmented Reality in Interior Design [3], published by Priya Singh, Sapna Dewari, Preeti Singh and Sachin Jain in Mar 2019. They proposed a method of building a mobile app that allows to visualize and interact with the furniture using their smartphones in augmented reality environment. They used Markerless AR technology that permits the application to use phone camera and sensors to directly place a 3D object with the area seen by the camera [3]. The limitations in their technology were:

- They used local storage to store 3D models that resulted in a big APK size
- App was not able to render 3D models in live feed

Future scope stated by them was to integrate photogrammetry to their existing platform which will allow them to reconstruct a 3d model of furniture from pictures. As of now the user can only visualize the 3d models that are in the local storage, they wanted to expand this functionality. They intend to connect the app to a cloud repository from which a user could browse furniture and import it during runtime.

3. Marker-based AR -Project the camera on the marker [8]: published by Geeta Koli, Shubhangi Sangnale, Priyanka Shinde, Nilam Deshpande, A. M. Wade in July 2016. They proposed a method of Marker Based AR technology.

The marker will be detected, the coordinates of the marker will be calculated and 3D objects will be placed dynamically. The limitations in their technology were:

- When the mobile camera is moved away from the marker, AR experience disappears and the trigger photo has to be scanned again. It is possible to use extended tracking, but in most cases, extended tracking makes things worse.
- Scanning will not work if markers reflect light in certain situations.
- Marker has to have strong borders/contrast between black and white colors to make tracking more stable. Smooth color transition will make recognition impossible.

Future scope stated by them were:

• Considering the problem faced by the people while selecting the furniture for interior design they have proposed the marker based Augmented Reality application.

• This application can be used by all the users having android handset or tablet to conveniently design their interiors.

III. PROPOSED WORK

Our proposed work is a pipeline of different frameworks and APIs. A React Native front end cross platform application that works on both Android and iOS, an Express Server delivering responses to API requests from React Native Application, a MongoDB NoSQL Server storing the data of application users and furniture and AWS S3 cloud storage for storing 3D models, textures and their high-resolution images in form of objects.

Based on the previous literature we consolidated the following information to do a comparative analysis of previously proposed methods and how we overcome them.

Table 1. comparative Analysis

Title	Authors	Method	Merits	Limitations	Solutions
Markerless Augmented Reality Android App for Interior Decoration	Prasad Renukdas, Rohit Ghundiyal, Harshavardhan Gadgil, Vishal Pathare Year - April 2016	Markerless Based AR Approach	Utilised Metaio SDK (4.1) which provided high level abstraction, advanced tracking, support for a wide range of formats and direct loading of the 3D models.	Used local storage to store 3D models. Resolution of 3d models and textures used were of low quality	Use File Storage such as AWS S3. Use high quality 3D models and textures
Interior Design using Augmented Reality	Geeta Koli, Shubhangi Sangnale, Priyanka Shinde, Nilam Deshpande, A. M. Wade Year - July 2016	Marker Based AR Approach	No specific merits as such.	AR experience disappears when the camera is moved away from the marker. The trigger marker scanning becomes difficult if it is tampered and results in poor AR experience.	Use a Markerless AR based approach to have a better AR experience.
Augmented Reality in Interior Design	Priya Singh, Sapna Dewari, Preeti Singh, Sachin Jai Year - March 2019	Markerless Based AR Approach	Provided different textures for 3D Models.	3D Model rendering is not possible in live feed. Uses local storage to store 3D models.	Use Viro Media which provides AR toolkit to make live possible. Use File Storage such as AWS S3.

So based on the previous studies, we provide a few solutions to the limitations of their work. We want use the following to overcome their limitations:

Table 2. Solutions

Method	Solutions
Markerless Based Approach of Augmented Reality	1. Use File Storage such as AWS S3.
	2. Use high quality 3D models and textures
	3. Use Viro Media which provides AR toolkit to make live rendering

IV. CONCLUSION

An Augmented Reality system supplements the real world with virtual (computer-generated) objects that appear to coexist in the same space as the real world. Augmented Reality systems combine digital information and the real world in a way that the user experiences them as one. After analyzing the previous work accomplished in this field of study, this research paper proposes a full-fledged architectural pipeline of frameworks. This framework utilizes React Native Framework for cross-platform application development, an Express Server as a backend server to enable resource sharing between frontend and a MongoDB NoSQL Database. The framework also includes Amazon S3 which offers object storage for the 3D models, texture and their high-resolution images from all sides. The technology that will help us achieve AR functionality is Viro React. Viro React provides a great performance efficiency on iOS and Android platforms. This open-source library really makes AR/VR development very easy and productive so that developers can focus on actually developing unique ideas rather than wasting time in writing native code for different platforms.

This research paper analyses the use of Markerless AR technology, and its components such as plane detection and 3D model real-time rendering in addition to storing heavy 3D models, textures and their high-resolution images on cloud platforms rather than using local storage.

Thus, this review has a long way to go. With ongoing advancements in AR/VR and Interior Design we can improve and enhance the AR/VR experience.

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REFERENCES

[1] “The Lengthy History of Augmented Reality". Huffington Post. 15 May 2016

[2] V. T. Phan and S. Y. Choo. “Interior Design in Augmented Reality Environment”, International Journal of Computer Applications, Vol. 5, No. 5, pp. 16–21, 2010

[3] Priya Singh, Sapna Dewari, Preeti Singh, Sachin Jai “Augmented Reality in Interior Design”, International Research Journal of Engineering and Technology (IRJET), Volume: 06 Issue: 03 | Mar 2019

[4] https://github.com/virocommunity/viro#readme

[5] "Amazon Web Services Launches "Amazon S3"" (Press release). 2006-03-14. Archived from the original on 2018-11-15. Retrieved 2018-11-14.

[6] Huang, Dijiang; Wu, Huijun (2017-09-08). Mobile Cloud Computing: Foundations and Service Models. Morgan Kaufmann. p. 67. ISBN 9780128096444. Archived from the original on 2018-11-15. Retrieved 2018-11-15.

[7] Prasad Renukdas, Rohit Ghundiyal, Harshavardhan Gadgil, Vishal Pathare “Markerless Augmented Reality Android App for Interior Decoration” International Journal of Engineering Research & Technology (IJERT) Vol. 2 Issue 4, April – 2013

[8] Geeta Koli, Shubhangi Sangnale, Priyanka Shinde, Nilam Deshpande, A. M. Wade “Interior Design using Augmented Reality” International Journal of Computer Applications (0975-888)